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(54) **Shift prohibiting for automatic shift preselection mode for mechanical transmission system with semi-automatic shift implementation.**

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EP-A- 0 107 761
DE-A- 3 334 721
US-A- 4 361 060
US-A- 4 555 959

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US-A- 4 648 290
PATENT ABSTRACTS OF JAPAN vol. 11, no. 255 (M-617)(2702) 19 August 1987, & JP-A-62 62048 (KOMATSU LTD) 18 March 1987,

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Description

RELATED APPLICATIONS

This Application is related in subject matter to US-A-5 053 961 titled SEMI-AUTOMATIC SHIFT IMPLEMENTATION FOR MECHANICAL TRANSMISSION SYSTEM; US-A-5 053 959, titled CONTROL SYSTEM AND METHOD FOR SENSING AND INDICATING NEUTRAL IN A SEMI-AUTOMATIC MECHANICAL TRANSMISSION SYSTEM; US-A-5 063 511, titled ENHANCED MISSED SHIFT RECOVERY FOR SEMI-AUTOMATIC SHIFT IMPLEMENTATION CONTROL SYSTEM; US-A-4 991 099, titled CONTROL SYSTEM/METHOD FOR CONTROLLING SHIFTING OF A RANGE TYPE COMPOUND TRANSMISSION USING INPUT SHAFT AND MAINSHAFT SPEED SENSORS; and US-A-5 053 962, titled AUTOMATIC SHIFT PRESELECTION MODE FOR MECHANICAL TRANSMISSION SYSTEM WITH SEMI-AUTOMATIC SHIFT IMPLEMENTATION; all assigned to Eaton Corporation, the assignee of this Application, and all filed June 19, 1989.

BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to vehicular semi-automatic mechanical transmission systems and, in particular, to semi-automatic mechanical transmission systems of the type providing partially automatic implementation of preselected shifting of mechanical transmission gear ratios and having at least one mode of operation wherein the shifting of ratio changes are automatically preselected by the system central processing unit.

In particular, the present invention relates to means to inhibit shifting of the transmission into neutral under certain conditions, such as low speed cornering, or high speed operation, or sensing operation of the vehicle brakes and/or retarder, by way of example, wherein such a shift may be unexpected and/or distracting to the vehicle operator.

Description of the Prior Art

Fully automatic transmission systems, both for heavy-duty vehicles such as heavy-duty trucks, and for automobiles, that sense throttle openings or positions, vehicle speeds, engine speeds, and the like, and automatically shift the vehicle transmission in accordance therewith, are well known in the prior art. Such fully automatic change gear transmission systems include automated transmissions wherein pressurized fluid is utilized to frictionally engage one or more members to other members or to a ground to achieve a selected gear ratio as well as automated mechanical transmissions utilizing electronic and/or pneumatic logic and actuators to engage and disengage mechanical (i.e. positive) clutches to achieve a desired gear ratio. Examples of such transmissions may be seen by reference to U.S. A 3,961,546; 4,081,065 and 4,361,060.

Such fully automatic change gear transmissions can be unacceptably expensive, particularly for the largest heavy-duty vehicles which are not typically sold in high volumes. Additionally, those automatic change gear transmissions utilizing pressurized fluid and/or torque converters tend to be relatively inefficient in terms of power dissipated between the input and output shafts thereof.

Semi-automatic transmission systems utilizing electronic control units which sense throttle position, engine, input shaft, output shaft and/or vehicle speed, and utilize automatically controlled fuel throttle devices, gear shifting devices and/or master clutch operating devices to substantially fully automatically implement operator manually selected transmission ratio changes are known in the prior. Examples of such semi-automatic transmission systems may be seen by reference to U.S.-A- Nos. 4,425,620; 4,631,679 and 4,648,290.

While such semi-automatic mechanical transmission systems are very well received as they are somewhat less expensive than fully automatic transmission systems, allow manual clutch control for low speed operation and/or do not require automatic selection of the operating gear ratio, they may be too expensive for certain applications as a relatively large number of sensors and automatically controllable actuators, such as a master clutch and/or a fuel throttle device actuator, are required to be provided, installed and maintained.

EP-A-0 107 761 discloses the state of the art comprising an electronic shift control wherein the output speed of the transmission is measured, the input speed can be calculated from a determination of the engaged ratio and either the manually selected next ratio is engaged by actuators or the optimum ratio in the up or down direction is engaged when in automatic mode. The selection of the speed ratios is checked automatically for over-running of the engine. In order to inform shift progress to the driver, the depressed button 53 is maintained depressed during the shift and can only be depressed further after the completion of the shift. The up or down direction of shift may be preselected. This reference thus proposed the precharacterizing part of Claim 1. US-A-4 648 290 discloses provision of a signal denoting the speed of the input shaft of a semi-automatic transmission.

SUMMARY OF THE INVENTION

In accordance with embodiments of the present invention, which is defined in Claims 1 and 10, the

drawbacks of the prior art are overcome or minimized by the provision of a semi-automatic shift implementation system/method for a mechanical transmission system for use in vehicles having a manually only controlled engine throttle means, and a manually only controlled master clutch. The system has at least one mode of operation wherein the shifts to be semi-automatically implemented are automatically preselected and includes a control/display panel or console for operator selection of operation in the automatic preselection mode and indication of automatic preselection of upshifts, downshifts or shifts into neutral. An electronic control unit (ECU) is provided for receiving input signals indicative of transmission input and output shaft speeds and for processing same in accordance with predetermined logic rules to determine if an upshift or downshift from the currently engaged ratio is required and to issue command output signals to a transmission actuator for shifting the transmission in accordance with the command output signals.

Under certain conditions, implementation of an automatically preselected shift is prohibited to prevent unexpected and/or undesirable shifts. Preferably, the operator is provided with means, such as manual depression of the clutch pedal, to release the shift prohibiting means.

Conditions at which implementation of automatically preselected shifts should be prohibited may include relatively high or relatively low vehicle speed, operation of the vehicle brakes and/or retarder, and/or the fuel throttle in the idle position.

The control/display device will display the selected but not yet implemented shift as well as the current status of the transmission, and, preferably will also allow the operator to manually select/preselect a shift into a higher ratio, a lower ratio or into neutral. Preferably, the control device will also allow a manually or an automatically preselected shift to be cancelled.

Accordingly, a control system/method for a vehicular semi-automatic mechanical transmission system for partially automatic implementation of automatically selected transmission shifts is provided which does not require throttle or clutch actuators, which requires only two speed signal inputs, and which, under preselected conditions, such as relatively high or relatively low vehicle speeds, will prohibit initiation of an automatically preselected shift until a specific action is taken by the vehicle operator, is provided.

This and other objects and advantages of the present invention will become apparent from a reading of the detailed description of the preferred embodiment taken in connection with the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic illustration of the vehicular mechanical transmission system partially automated by the system of the present invention.

Figure 1A is a schematic illustration of the shift pattern of the transmission of Figure 1.

Figure 2 is a schematic illustration of the automatic preselect and semi-automatic shift implementation system for a mechanical transmission system of the present invention.

Figure 3 is a schematic illustration of an alternate control console for the system of Figure 2.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Certain terminology will be used in the following description for convenience in reference only and will not be limiting. The words "upwardly", "downwardly", "rightwardly", and "leftwardly" will designate directions in the drawings to which reference is made. The words "forward", "rearward", will refer respectively to the front and rear ends of the transmission as conventionally mounted in a vehicle, being respectfully from left and right sides of the transmission as illustrated in Figure 1. The words "inwardly" and "outwardly" will refer to directions toward and away from, respectively, the geometric center of the device and designated parts thereof. Said terminology will include the words above specifically mentioned, derivatives thereof and words of similar import.

The term "compound transmission" is used to designate a change speed or change gear transmission having a multiple forward speed main transmission section and a multiple speed auxiliary transmission section connected in series whereby the selected gear reduction in the main transmission section may be compounded by further selected gear reduction in the auxiliary transmission section. "Synchronized clutch assembly" and words of similar import shall designate a clutch assembly utilized to nonrotatably couple a selected gear to a shaft by means of a positive clutch in which attempted engagement of said clutch is prevented until the members of the clutch are at substantially synchronous rotation. A relatively large capacity friction means are utilized with the clutch members and are sufficient, upon initiation of a clutch engagement, to cause the clutch members and all members rotating therewith to rotate at substantially synchronous speed.

The term "upshift" as used herein, shall mean the shifting from a lower speed gear ratio into a higher speed gear ratio. The term "downshift" as used herein, shall mean the shifting from a higher speed gear ratio to a lower speed gear ratio. The terms "low speed gear", "low gear" and/or "first gear" as used herein, shall all designate the gear ratio utilized for lowest forward speed operation in a transmission or transmission section, i.e., that set of gears having the highest ratio of reduction relative to the input shaft of the transmission.

A "selected direction" of shifting will refer to selection of either single or multiple upshifting or downshifting from a particular gear ratio.

Referring to Figure 1, a range type compound transmission 10 of the type partially automated by the semi-automatic mechanical transmission system having an automatic preselect mode of operation of the present invention is illustrated. Compound transmission 10 comprises a multiple speed main transmission section 12 connected in series with a range type auxiliary section 14. Transmission 10 is housed within a housing H and includes an input shaft 16 driven by a prime mover such as diesel engine E through a selectively disengaged, normally engaged friction master clutch C having an input or driving portion 18 drivingly connected to the engine crankshaft 20 and a driven portion 22 rotatably fixed to the transmission input shaft 16.

The engine E is fuel throttle controlled by a manually controlled throttle device (not shown) and the master clutch C is manually controlled by a clutch pedal (not shown) or the like. An input shaft brake B, operated by overtravel depression of the clutch pedal, is preferably provided to provide quicker upshifting as is well known in the prior art.

Transmissions similar to mechanical transmission 10 are well known in the prior art and may be appreciated by reference to US-A-.3,105,395; 3,283,613 and 4,754,665.

In main transmission section 12, the input shaft 16 carries an input gear 24 for simultaneously driving a plurality of substantially identical countershaft assemblies 26 and 26A at substantially identical rotational speeds. The two substantially identical countershaft assemblies are provided on diametrically opposite sides of mainshaft 28 which is generally coaxially aligned with the input shaft 16. Each of the countershaft assemblies comprises a countershaft 30 supported by bearings 32 and 34 in housing H, only a portion of which is schematically illustrated. Each of the countershafts is provided with an identical grouping of countershaft gears 38, 40, 42, 44, 46 and 48, fixed for rotation therewith. A plurality of mainshaft gears 50, 52, 54, 56 and 58 surround the mainshaft 28 and are selectively clutchable, one at a time, to the mainshaft 28 for rotation therewith by sliding clutch collars 60, 62 and 64 as is well known in the prior art. Clutch collar 60 may also be utilized to clutch input gear 24 to mainshaft 28 to provide a direct drive relationship between input shaft 16 and mainshaft 28.

Typically, clutch collars 60, 62 and 64 are axially positioned by means of shift forks associated with the shift housing assembly 70, as well known in the prior art. Clutch collars 60, 62 and 64 may be of the well known nonsynchronized double acting jaw clutch type.

Shift housing or actuator 70 is actuated by compressed fluid, such as compressed air, and is of the type automatically controllable by a control unit as may be seen by reference to US-A-. 4,445,393; 4,555,959; 4,361,060; 4,722,237 and 2,931,237.

Mainshaft gear 58 is the reverse gear and is in continuous meshing engagement with countershaft gears 48 by means of conventional intermediate idler gears (not shown). It should also be noted that while main transmission section 12 does provide five selectable forward speed ratios, the lowest forward speed ratio, namely that provided by drivingly connecting mainshaft drive gear 56 to mainshaft 28, is often of such a high gear reduction it has to be considered a low or "creeper" gear which is utilized only for starting of a vehicle under severe conditions and, is not usually utilized in the high transmission range. Accordingly, while main transmission section 12 does provide five forward speeds, it is usually referred to as a "four plus one" main section as only four of the forward speeds are compounded by the auxiliary range transmission section 14 utilized therewith.

Jaw clutches 60, 62, and 64 are three-position clutches in that they may be positioned in the centered, nonengaged position as illustrated, or in a fully rightwardly engaged or fully leftwardly engaged position by means of actuator 70. As is well known, only one of the clutches 60, 62 and 64 is engageable at a given time and main section interlock means (not shown) are provided to lock the other clutches in the neutral condition.

Auxiliary transmission range section 14 includes two substantially identical auxiliary countershaft assemblies 74 and 74A, each comprising an auxiliary countershaft 76 supported by bearings 78 and 80 in housing H and carrying two auxiliary section countershaft gears 82 and 84 for rotation therewith. Auxiliary countershaft gears 82 are constantly meshed with and support range/output gear 86 while auxiliary section countershaft gears 84 are constantly meshed with output gear 88.

A two-position synchronized jaw clutch assembly 92, which is axially positioned by means of a shift fork (not shown) and the range section shifting actuator assembly 96, is provided for clutching either gear 86 to output shaft 90 for direct or high range operation or gear 88 to output shaft 90 for low range operation of the compound transmission 10. The "shift pattern" for compound range type transmission 10 is schematically illustrated in Figure 1A.

Range section actuator 96 may be of the type illustrated in US-A- 3,648,546; 4,440,037 and 4,614,126.

Although the range type auxiliary section 14 is illustrated as a two-speed section utilizing spur or helical type gearing, it is understood that the present invention is also applicable to range type transmissions utilizing combined splitter/range type auxiliary sections, having three or more selectable range ratios and/or utilizing planetary type gearing. Also, any one

or more of clutches 60, 62 or 64 may be of the synchronized jaw clutch type and transmission sections 12 and/or 14 may be of the single countershift type.

For purposes of providing the automatic preselect mode of operation and the semi-automatic shift implementation operation of transmission 10, an input shaft speed sensor 98 and an output shaft speed sensor 100 are utilized. Alternatively to output shaft speed sensor 100, a sensor 102 for sensing the rotational speed of auxiliary section countershaft gear 82 may be utilized. The rotational speed of gear 82 is, of course, a known function of the rotational speed of mainshaft 28 and, if clutch 92 is engaged in a known position, a function of the rotational speed of output shaft 90.

The automatic preselect and semi-automatic shift implementation control system 104 for a mechanical transmission system of the present invention is schematically illustrated in Figure 2. Control system 104, in addition to the mechanical transmission system 10 described above, includes an electronic control unit 106, preferably microprocessor based, for receiving input signals from the input shaft speed sensor 98, from the output shaft speed sensor 100 (or, alternatively, the mainshaft speed sensor 102) and from the driver control console 108. The ECU 106 may also receive inputs from an auxiliary section position sensor 110.

The ECU is effective to process the inputs in accordance with predetermined logic rules to issue command output signals to a transmission operator, such as solenoid manifold 112 which controls the mainsection section actuator 70 and the auxiliary section actuator 96, and to the driver control console 108.

In the preferred embodiment, the driver control console allows the operator to manually select a shift in a given direction or to neutral from the currently engaged ratio, or to select a semi-automatic preselect mode of operation, and provides a display for informing the operator of the current mode of operation (automatic or manual preselection of shifting), the current transmission operation condition (forward, reverse or neutral) and of any ratio change or shift (upshift, downshift or shift to neutral) which has been preselected but not yet implemented.

Console 108 includes three indicator lights 114, 116 and 118 which will be lit to indicate that the transmission 10 is in a forward drive, neutral or reverse drive, respectively, condition. The console also includes three selectively lighted pushbuttons 120, 122, and 124 which allow the operator to select an upshift, automatic preselection mode or a downshift, respectively. A pushbutton 126 allows selection of a shift into neutral.

A selection is made by depressing or pushing any one of buttons 120, 122, 124 or 126 and may be cancelled (prior to execution in the case of buttons 120, 124 and 126) by redepressing the buttons. As an alternative, multiple depressions of buttons 120 and 124 may be used as commands for skip shifts. Of course, the buttons and lighted buttons can be replaced by other selection means, such as a toggle switch and/or a toggle switch and light or other indicia member. A separate button or switch for selection of reverse may be provided or reverse may be selected as a downshift from neutral. Also, neutral may be selected as an upshift from reverse or as a downshift from low.

In operation, to select upshifts and downshifts manually, the operator will depress either button 120 or button 124 as appropriate. The selected button will then be lighted until the selected shift is implemented or until the selection is cancelled.

Alternatively, at a given engine speed (such as above 1700 RPM) the upshift button may be lit and remain lit until an upshift is selected by pushing the button.

To implement a selected shift, the manifold 112 is preselected to cause actuator 70 to be biased to shift main transmission section 12 into neutral. This is accomplished by the operator causing a torque reversal by manually momentarily decreasing and/or increasing the supply of fuel to the engine and/or manually disengaging the master clutch C. As the transmission is shifted into neutral, and neutral is verified by the ECU (neutral sensed for a period of time such as 1.5 seconds), the neutral condition indicia button 116 is lighted. If the selected shift is a compound shift, i.e. a shift of both the main section 12 and of the range section 14, such as a shift from 4th to 5th speeds as seen in Figure 1A, the ECU will issue command output signals to manifold 112 to cause the auxiliary section actuator 96 to complete the range shift after neutral is sensed in the front box.

When the range auxiliary section is engaged in the proper ratio, the ECU will calculate or otherwise determine, and continue to update, an enabling range or band of input shaft speeds, based upon sensed output shaft (vehicle) speed and the ratio to be engaged, which will result in an acceptably synchronous engagement of the ratio to be engaged. As the operator, by throttle manipulation and/or use of the input shaft brake, causes the input shaft speed to fall within the acceptable range, the ECU 106 will issue command output signals to manifold 112 to cause actuator 70 to engage the mainsection ratio to be engaged. Preferably, the actuator will respond very quickly not requiring the operator to maintain the input shaft speed within the acceptable range for an extended period of time. To select a shift into transmission neutral, selection button 126 is pushed. Indicating light 116 will flash until the ECU confirms that neutral is obtained at which time the light 116 will assume a continuously lighted condition while the transmission remains in neutral.

In the automatic preselection mode of operation, selected by use of lighted pushbutton 122, the ECU will, based upon stored logic rules, currently engaged ratio (which may be calculated by comparing input shaft to output shaft speed) and output shaft or vehicle speed, determine if an upshift or a downshift is required and preselect same. The operator is informed that an upshift or downshift is preselected and will be semi-automatically implemented by a command output signal from ECU 106 causing either lighted pushbutton 120 or lighted pushbutton 124 to flash and/or an audible shift alert signal. The operator may initiate semi-automatic implementation of the automatically preselected shift as indicated above or may cancel the automatic mode and the shift preselected thereby by depression of pushbutton 122.

Under certain vehicle operating conditions, such as low speed cornering and/or high speed operation down a grade, a shift may be automatically preselected and unintentionally implemented, causing an unexpected shift from the previously engaged gear into neutral. To prevent this, at less or greater than a preselected vehicle speed, such as below 25 MPH (40 km/h) or more than 45 MPH (72 km/h), sensed by output shaft rotational speed, the logic rules of ECU 106 may prohibit initiation of a preselected shift until a shift initiation enable signal is manually issued by the operator. For this purpose, a switch 150, actuated by depression of the clutch pedal P may be provided. Means to releaseably prohibit implementation of preselected shifts are known in the prior art as may be seen by reference to US-A-. 4,555,959.

By allowing the operator to issue a shift enable signal by a simple depression of clutch pedal P, the operator may use both hands on the steering wheel and still obtain only expected shifting during, for example, a low speed operation such as cornering.

Alternatively, the logic rules of ECU 106 may prohibit initiation of an automatically preselected shift when the vehicle brakes are applied, a retarder is applied and/or the manual throttle is at idle. Of course, an additional sensor 152 may be required.

As an alternative, the neutral condition indication light 116 may be eliminated and neutral selection pushbutton 126 replaced by a lighted pushbutton.

An alternative driver control and display console 130 may be seen by reference to Figure 3. A joy stick 132 is movable against a resilient bias from its centered position to select upshifts, downshifts, a shift to neutral or the automatic preselect mode by movement up, down, leftward or rightward, respectively, as indicated. Indicia lights 134 and 136 are lighted to indicate an upshift or downshift, respectively, is preselected. Indicia lights 138 and 140, respectively, are lighted to indicate a vehicle forward or reverse, respectively, mode of operation. Indicia light 142 is steadily lighted to indicate a transmission neutral condition and is flashed to indicate a preselected but not yet confirmed neutral condition. Indicia light 144 is lighted to indicate system 104 is operating in the automatic preselection mode of operation.

Accordingly, it may be seen that a relatively simple and inexpensive semi-automatic shift implementation control system (104)/method for a mechanical transmission system 10 having an automatic preselect mode of operation and requiring only a transmission shift actuator (112/70/96) and two speed inputs to be added to vehicle mechanical transmission system is provided. An electronic control unit 106 for receiving the two speed inputs, and inputs from an operator's console and for issuing command outsignals to the actuators and to the display portion of the operator's console is also provided. The system semi-automatically executes manually or automatically preselected shifts requiring the operator to (i) cause a torque reversal for disengaging the currently engaged ratio and (ii) to cause substantially synchronous rotation for engagement of the selected ratio, which allows the system to operate without requiring automatically operated throttle controls or master clutch actuators.

Under certain conditions, such as for example, relatively high or relatively low vehicle speed, implementation of automatically or manually preselected shifts is prohibited until the operator manually releases the inhibiting means by manually causing a shift enabling signal to be issued to the ECU.

Claims

1. A control system (104) for semi-automatic implementation of automatically selected shifts of a vehicular mechanical change gear transmission system comprising a manually controlled fuel throttle controlled engine (E), a multi-speed change gear mechanical transmission (10), a manually controlled master friction clutch (C) drivingly interposed between the engine and the transmission, a first sensor (98) for providing a first input signal indicative of transmission input shaft (16) rotational speed, a second sensor (100) for providing a second input signal indicative of the rotational speed of a transmission signal shaft (90), a third sensor (150) for sensing manual issuance of a shift enable signal and a non-manually controllable transmission actuator (112, 70, 96) for controlling shifting of the transmission and indicia means (120,124) for presenting gear ratio information,

   a central processing unit (106) for receiving said first, second and third input signals and for processing same in accordance with predetermined logic rules to issue command output signals, said control system characterized by;

   said indicia means (120, 124) presenting

an indication of a selection but not yet confirmation of an upshift or a downshift from a currently engaged transmission ratio or from neutral to a selected ratio;

said central processing unit including;

(a) means for determining the desirability of a shift from a currently engaged ratio, to select such a shift if desirable and for issuing command output signals to said indicia means to provide an indication that an upshift or a downshift, as appropriate, has been selected;

(b) means responsive to (i) selection of a transmission shift from a currently engaged ratio and (ii) under predetermined conditions determined by comparing said second signal to a predetermined reference value, sensing manual issuance of said shift enable signal for issuing command output signals to said actuator to bias the transmission to be shifted into neutral;

(c) means responsive to (i) a selection of a shift from a currently engaged ratio into a selected ratio and (ii) confirmation of a transmission neutral condition for (i) sensing manual substantial synchronization of the transmission and (ii) thereafter for issuing command output signals to said actuator to cause the transmission to be shifted into the selected ratio; and

(d) means for confirming a selected shift has been implemented and for issuing command output signals to said indicia means to terminate the indication of a selected shift.

2. The control system of Claim 1 including a fourth sensor (152) for sensing actuation of the vehicle brakes, said predetermined conditions additionally comprising actuation of said brakes.

3. The control system of Claim 1 including a fourth sensor (152) for sensing actuation of a vehicle retarder, said predetermined conditions additionally comprising actuation of said retarder.

4. The control system of Claim 1 including a fourth sensor (152) for sensing actuation of a manual throttle control, said predetermined conditions additionally comprising said throttle control set to the idle position thereof.

5. The control system of any of Claims 1-4 wherein said means for sensing manual synchronization comprises means for determining a reference range of acceptable values of said first signal as a function of said second signal and means for comparing the current value of said first signal to said range of reference values.

6. The control system of any of Claims 2-5, additionally comprising means allowing a selection to be manually cancelled.

7. The control system of any of Claims 1-4 wherein said third sensor senses manual operation of said master friction clutch.

8. The control system of Claim 5 wherein said third sensor senses manual operation of said master friction clutch.

9. The control system of any of Claims 1-8 additionally including indicia means (114, 116, 118/138, 140, 142) for indicating the current status (FOR, NEUT, REV) of the transmission.

10. A control method, for semi-automatic implementation of automatically selected shifts of a vehicular mechanical change gear transmission system comprising a manually controlled fuel throttle controlled engine (E), a multi-speed change gear mechanical transmission (10), a manually controlled master friction clutch (C) drivingly interposed between the engine and the transmission, said method comprising providing by means of a first sensor (98) a first input signal indicative of transmission input shaft (16) rotational speed, providing by means of a second sensor (100;102) a second input signal indicative of the rotational speed of a transmission shaft (90;28), controlling by means of a non-manually controllable transmission actuator (112, 70, 96) and by means of gear ratio indicia means the shifting of the transmission under control of a central processing unit receiving the first and second input signals, said control system characterized by;

arranging that said indicia means (120, 124) provide an indication of a selection but not yet a confirmation of an upshift or a downshift from a currently engaged transmission ratio or from neutral to a selected ratio;

processing said first and second input signals by means of said unit (106) processing in accordance with predetermined logic rules;

(a) to determine the desirability of a shift from a currently engaged ratio, to select such a shift if desirable and to issue command output signals to said indicia means to provide an indication that an upshift or a downshift, as appropriate, has been selected;

(b) to sense the presence or absence of predetermined conditions at which implementation of a preselected shift is to be prohibited;

(c) to respond to (i) selection of a transmission shift from a currently engaged ratio and (ii) the absence of said predetermined conditions, by issuing further command output sig-

nals to said actuator to bias the transmission to be shifted into neutral;
(d) to respond to both (i) a selection of a shift from a currently engaged ratio into a selected ratio and (ii) confirmation of a transmission neutral condition thereby (i) sensing manual substantial synchronization of the transmission and (ii) thereafter issuing yet further command output signals to said actuator to cause the transmission to be shifted into the selected ratio; and
(e) to confirm that a selected shift has been implemented and to issue further command output signals to said indicia means to terminate the indication of a selected shift.

11. The control method of Claim 10 operative such that said second input signal is continuously indicative of the speed of the transmission output shaft (90) and such that said predetermined conditions comprise said second signal being less than a predetermined reference value.

12. The control method of Claim 10 or 11 operative so that a third sensor senses a manually controlled fuel throttle at idle fuel position, and said predetermined conditions comprise said manually set fuel throttle being set at idle.

13. The control system of Claim 10 or 11 operative so that a third sensor senses vehicle brakes being applied, and said predetermined conditions comprise said vehicle brakes being applied.

14. The control system of Claim 10 or 11 operative so that a third sensor senses a vehicle retarder being applied, and said predetermined conditions comprise said vehicle retarder being applied.

Patentansprüche

1. Steuersystem (104) für ein halbautomatisches Einlegen automatisch ausgewählter Gänge eines mechanischen Geschwindigkeitwechselgetriebesystems für ein Kraftfahrzeug, mit einem durch eine vom Fahrer gesteuerte Kraftstoffdrossel gesteuerten Motor (E), mit einem vielgängigen mechanischen Geschwindigkeitswechselgetriebe (10), mit einer vom Fahrer gesteuerten Reibungshauptkupplung (C), die antriebsmäßig zwischen dem Motor und dem Getriebe angeordnet ist, mit einem ersten Sensor (98) zur Abgabe eines ersten Eingangssignales, das für die Drehzahl der Getriebeeingangswelle (16) kennzeichnend ist, mit einem zweiten Sensor (100) zur Abgabe eines zweiten Eingangssignales, das für die Drehzahl einer Getriebeausgangswelle (90) kennzeichnend ist, mit einem dritten Sensor (150) zum Feststellen einer vom Fahrer veranlaßten Ausgabe eines Schaltfreigabesignals sowie mit einem nicht vom Fahrer steuerbaren Getriebeaktuator (112, 70, 96) zum Steuern des Schaltens des Getriebes sowie mit Anzeigemitteln (120, 124) zum Anzeigen einer Gangstufeninformation,
mit einer zentralen Prozessoreinheit (106) zum Empfangen der ersten, zweiten und dritten Eingangssignale und zum Verarbeiten derselben entsprechend vorbestimmter logischer Regeln, um Befehlsausgangssignale zu erzeugen, wobei das Steuersystem dadurch gekennzeichnet ist, daß
die Anzeigemittel (120, 124) eine Anzeige für die Auswahl, jedoch keine Bestätigung eines Herauf- oder Herunterschaltens aus einer gegenwärtig eingelegten Getriebegangstufe oder aus dem Leerlauf in ein ausgewähltes Gangstufenverhältnis liefern;
wobei die zentrale Prozessoreinheit folgendes aufweist;
(a) Mittel zur Bestimmung der Zweckmäßigkeit eines Schaltens aus einem gegenwärtig eingelegten Gang, um, wenn es erforderlich ist, solch ein Schalten auszuwählen, und zum Ausgeben von Befehlsausgangssignalen an die Anzeigemittel, um eine Anzeige zu liefern, daß, je nach dem was zweckmäßig ist, ein Herauf- oder Herunterschalten ausgewählt worden ist;
(b) Mittel, die auf (i) die Auswahl eines Schaltens aus einem gegenwärtig eingelegten Gang reagieren und die (ii), unter vorbestimmten Bedingungen, die durch das Vergleichen des zweiten Signals mit einem vorbestimmten Referenzwert bestimmt sind, die vom Fahrer veranlaßte Erzeugung des Schaltfreigabesignals zur Ausgabe von Befehlsausgangssignalen an den Aktuator feststellen, um das Getriebe im Sinne auf das Schalten in den Leerlauf vorzuspannen;
(c) Mittel, die in Abhängigkeit von (i) einer Auswahl eines Schaltens aus einer gegenwärtig eingelegten Gangstufe in eine angewählte Gangstufe und (ii) der Bestätigung einer Getriebeleerlaufbedingung arbeiten, um (i) festzustellen, daß vom Fahrer im wesentlichen Synchronlauf im Getriebe hergestellt ist, und (ii) danach Befehlsausgangssignale an den Aktuator auszugeben, um das Getriebe zu veranlassen, in den angewählten Gang zu schalten; und
(d) Mittel zum Bestätigen, daß ein angewähltes Schalten ausgeführt worden ist und zum Ausgeben von Befehlsausgangssignalen an die Anzeigemittel, um die Anzeige eines aus-

gewählten Ganges zu beenden.

2. Steuersystem nach Anspruch 1, bei dem ein vierter Sensor (152) zum Feststellen der Aktivierung der Fahrzeugbremsen vorgesehen ist und bei dem die vorbestimmten Bedingungen zusätzlich beinhalten, daß die Bremsen aktiviert sind.

3. Steuersystem nach Anspruch 1, bei dem ein vierter Sensor (152) zum Feststellen der Aktivierung eines Fahrzeugretarders vorgesehen ist und bei dem die vorbestimmten Bedingungen zusätzlich beinhalten, daß der Retarder aktiviert ist.

4. Steuersystem nach Anspruch 1, bei dem ein vierter Sensor (152) zum Feststellen der Betätigung einer fahrerbetätigten Drosselsteuerung vorgesehen ist und bei dem die vorbestimmten Bedingungen zusätzlich die Einstellung der Drosselsteuerung in ihre Leerlaufposition beinhalten.

5. Steuersystem nach einem der Ansprüche 1 bis 4, bei dem die Mittel zum Feststellen der vom Fahrer herbeigeführten Synchronisation Mittel zum Bestimmen eines Referenzbereiches von akzeptablen Werten des ersten Signales als eine Funktion des zweiten Signales sowie Mittel zum Vergleichen des gegenwärtigen Wertes des ersten Signales mit dem Bereich der Referenzwerte aufweisen.

6. Steuersystem nach einem der Ansprüche 2 bis 5, das zusätzlich Mittel aufweist, die es gestatten, eine Auswahl seitens des Fahrers aufzuheben.

7. Steuersystem nach einem der Ansprüche 1 bis 4, bei dem der dritte Sensor eine Fahrerbetätigung der Reibungshauptkupplung feststellt.

8. Steuersystem nach Anspruch 5, bei dem der dritte Sensor die Fahrerbetätigung der Reibungshauptkupplung feststellt.

9. Steuersystem nach einem der Ansprüche 1 bis 8, das zusätzlich Anzeigemittel (114, 116, 118/138, 140, 142) aufweist, um den gegenwärtigen Zustand (vorwärts, Leerlauf rückwärts) des Getriebes anzuzeigen.

10. Steuerverfahren für halbautomatisches Einlegen automatisch ausgewählter Gänge eines mechanischen Geschwindigkeitswechselgetriebesystems für ein Kraftfahrzeug, mit einem durch eine vom Fahrer gesteuerte Kraftstoffdrossel gesteuerten Motor (E), mit einem vielgängigen mechanischen Geschwindigkeitswechselgetriebe (10), mit einer manuell gesteuerten Reibungshauptkupplung (C), die antriebsmäßig zwischen dem Motor und dem Getriebe angeordnet ist, wobei das Verfahren das Liefern eines ersten Eingangssignales, das für die Drehzahl der Getriebeeingangswelle (16) kennzeichnend ist, mittels eines ersten Sensors (98), das Liefern eines zweiten Eingangssignales, das für die Drehzahl einer Getriebewelle (90, 28) kennzeichnend ist, mittels eines zweiten Sensors (100, 102), sowie das Steuern des Schaltens des Getriebes mittels eines nicht vom Fahrer steuerbaren Getriebeaktuators (112, 70, 96) und mittels Anzeigemittel (120, 124) zum Anzeigen einer Gangstufeninformation unter der Steuerung einer zentralen Prozessoreinheit, die die ersten und die zweiten Eingangssignale empfängt,
wobei das Steuersystem gekennzeichnet ist, durch:
das Einrichten, daß die Anzeigemittel (120, 124) eine Anzeige einer Auswahl, jedoch noch keine Bestätigung eines Aufwärts- oder Abwärtsschaltens aus einer gegenwärtig eingelegten Getriebegangstufe oder aus dem Leerlauf in eine ausgewählten Gangstufe liefern;
das Verarbeiten der ersten und zweiten Eingangssignale mittels der Einheit (106), die gemäß vorbestimmter logischer Regeln arbeitet;
(a) das Bestimmen der Zweckmäßigkeit eines Schaltens von einem gegenwärtig eingelegten Gang, um, wenn es zweckmäßig ist, solch ein Schalten auszuwählen und zum Ausgeben von Kommandoausgangssignalen an die Anzeigemittel, um eine Anzeige zu liefern, daß, je nach dem was zweckmäßig ist, ein Herauf- oder Herunterschalten ausgewählt worden ist;
(b) das Feststellen des Vorhandenseins oder des Fehlens vorbestimmter Bedingungen, bei denen das Einlegen eines vorausgewählten Ganges zu sperren ist;
(c) das Reagieren auf (i) die Auswahl eines Getriebeschaltens aus einem gegenwärtig eingelegten Gang und (ii) das Fehlen der vorbestimmten Bedingungen, indem weitere Befehlsausgangssignale an den Aktuator ausgegeben werden, um das Getriebe im Sinne auf das Schalten in den Leerlauf vorzuspannen;
(d) das Reagieren auf sowohl (i) eine Auswahl eines Schaltens aus einem gegenwärtig eingelegten Gang in einen ausgewählten Gang als auch auf (ii) die Bestätigung einer Getriebeleerlaufbedingung wobei (i) festgestellt wird, daß vom Fahrer im wesentlichen Synchronlauf im Getriebes hergestellt ist, sowie (ii) danach noch weitere Befehlsausgangssignale an den Aktuator ausgegeben werden, um das Getriebe zu veranlassen, in den ausgewählten Gang zu schalten; und
(e) das Bestätigen, daß ein angewählter Gang

eingelegt worden ist, sowie das Ausgeben weiterer Befehlsausgangssignale an die Anzeigemittel, um die Anzeige eines angewählten Ganges zu beenden.

11. Steuerverfahren nach Anspruch 10, das derart arbeitet, daß das zweite Eingangssignal ständig die Drehzahl der Getriebeausgangswelle (90) anzeigt und daß die vorbestimmten Bedingungen beinhalten, daß das zweite Signal kleiner als ein vorbestimmter Referenzwert ist.

12. Steuerverfahren nach Anspruch 10 oder 11, das derart arbeitet, daß ein dritter Sensor feststellt, wenn eine vom Fahrer gesteuerte Kraftstoffdrossel in Kraftstoffleerlaufposition steht und daß die vorbestimmten Bedingungen beinhalten, daß die vom Fahrer eingestellte Kraftstoffdrossel in die Leerlaufposition eingestellt ist.

13. Steuersystem nach Anspruch 10 oder 11, das derart betrieben wird, daß ein dritter Sensor das Aktivieren der Fahrzeugbremsen feststellt und daß die vorbestimmten Bedingungen beinhalten, daß die Fahrzeugbremsen aktiviert sind.

14. Steuersystem nach Anspruch 10 oder 11, das derart arbeitet, daß ein dritter Sensor das Aktivieren eines Fahrzeugretarders feststellt und daß die vorbestimmten Bedingungen beinhalten, daß der Fahrzeugretarder aktiviert ist.

Revendications

1. Système de commande (104) pour exécuter de façon semi-automatique des changements de rapport, sélectionnés de façon automatique, dans un système de transmission mécanique pour véhicule, comprenant un moteur (E) commandé par un papillon des gaz commandé manuellement, une transmission mécanique à rapports multiples (10), un embrayage principal à friction (C) commandé manuellement et intercalé, selon une liaison motrice, entre le moteur et la transmission, un premier capteur (98) servant à délivrer un premier signal de sortie indicatif de la vitesse de rotation de l'arbre d'entrée (16) de la transmission, un second capteur (100) servant à délivrer un second signal d'entrée indicatif de la vitesse de rotation d'un arbre de sortie (90) de la transmission, un troisième capteur (150) servant à détecter l'application manuelle d'un signal d'autorisation de changement de rapport, et un actionneur (112, 70, 96) de la transmission, qui peut être commandé d'une manière non manuelle et sert à commander le changement de rapport dans la transmission, et des moyens de signalisation (120, 124) servant à fournir une information concernant le rapport de transmission,

une unité centrale de traitement (106) servant à recevoir lesdits premier, second et troisième signaux d'entrée et traiter ces signaux conformément à des règles logiques prédéterminées pour délivrer des signaux de sortie de commande;

ledit système de commande étant caractérisé en ce que

lesdits moyens de signalisation (120, 124) présentent une indication d'une sélection, mais pas encore une confirmation d'un passage à un rapport supérieur ou d'un passage à un rapport inférieur à partir d'un rapport de transmission actuellement engagé ou à partir de la position neutre en direction d'un rapport sélectionné;

ladite unité centrale de traitement comprenant :

(a) des moyens pour déterminer le caractère souhaitable d'une commutation à partir d'un rapport actuellement engagé, pour sélectionner un tel changement de rapport si cela est souhaitable, et pour envoyer des signaux de sortie de commande auxdits moyens de signalisation pour fournir l'indication du fait que, selon ce qui est approprié, un passage à un rapport supérieur ou un passage à un rapport inférieur a été sélectionné;

(b) des moyens répondant à (i) une sélection d'un changement de rapport de transmission à partir d'un rapport actuellement engagé, et (ii) détectant, dans des conditions prédéterminées, qui sont fixées par la comparaison entre ledit second signal et une valeur de référence prédéterminée, l'envoi manuel dudit signal d'autorisation de changement de rapport pour l'envoi de signaux de sortie de commande audit actionneur afin d'activer la transmission pour qu'elle soit commutée dans la position neutre;

(c) des moyens répondant à (i) une sélection d'une commutation de la transmission d'un rapport actuellement engagé à un rapport sélectionné, et à (ii) la confirmation d'une position neutre de la transmission pour (i) détecter une quasi-synchronisation manuelle de la transmission et (ii) envoyer ensuite des signaux de sortie de commande audit actionneur pour commuter la transmission sur le rapport sélectionné; et

(d) des moyens pour confirmer qu'un changement de rapport sélectionné a été exécuté et pour envoyer des signaux de sortie de commande auxdits moyens de signalisation pour interrompre l'indication d'un changement de rapport sélectionné.

2. Système de commande selon la revendication 1, comprenant un quatrième capteur (152) servant à détecter l'actionnement des freins du véhicule, lesdites conditions prédéterminées comprenant en outre l'actionnement desdits freins.

3. Système de commande selon la revendication 1, comprenant un quatrième capteur (152) servant à détecter l'actionnement d'un ralentisseur du véhicule, lesdites conditions prédéterminées incluant en outre l'actionnement dudit ralentisseur.

4. Système de commande selon la revendication 1, comprenant un quatrième capteur (152) servant à détecter l'actionnement d'une commande manuelle du papillon des gaz, lesdites conditions prédéterminées incluant en outre ladite commande du papillon des gaz réglée dans sa position de ralenti.

5. Système de commande selon l'une quelconque des revendications 1-4, dans lequel lesdits moyens servant à détecter une synchronisation manuelle comprennent des moyens pour déterminer une gamme de référence de valeurs admissibles dudit premier signal en fonction dudit second signal, et des moyens pour comparer la valeur actuelle dudit premier signal à ladite gamme de valeurs de référence.

6. Système de commande selon l'une quelconque des revendications 2-5, comprenant en outre des moyens permettant d'annuler manuellement une sélection.

7. Système de commande selon l'une quelconque des revendications 1-4, dans lequel ledit troisième capteur détecte un actionnement manuel dudit embrayage principal à friction.

8. Système de commande selon la revendication 5, dans lequel ledit troisième capteur détecte un actionnement manuel dudit embrayage principal à friction.

9. Système de commande selon l'une quelconque des revendications 1-8, comprenant en outre des moyens de signalisation (114, 116, 118/138, 140, 142) servant à indiquer l'état actuel (marche avant, neutre, marche arrière) de la transmission.

10. Procédé de commande pour l'exécution semi-automatique de changements de rapport, sélectionnés de façon automatique, dans un système de transmission mécanique pour véhicule, comprenant un moteur (E) commandé par un papillon des gaz commandé manuellement, une transmission mécanique à rapports multiples (10), un embrayage principal à friction (C) commandé manuellement et intercalé, selon une liaison motrice, entre le moteur et la transmission, ledit procédé consistant à obtenir, à l'aide d'un premier capteur (98), un premier signal de sortie indicatif de la vitesse de rotation de l'arbre d'entrée (16) de la transmission, obtenir, au moyen d'un second capteur (100; 102), un second signal d'entrée indicatif de la vitesse de rotation de l'arbre (90; 78) de la transmission, commander, à l'aide d'un actionneur non commandable manuellement (112, 70, 96) de la transmission et à l'aide des moyens de signalisation indiquant le rapport de transmission, le changement de rapport de la transmission sous la commande d'une unité centrale de traitement qui recoit les premier et second signaux d'entrée, ledit procédé de commande étant caractérisé en ce qu'il consiste

à prévoir que lesdits moyens de signalisation (120, 124) délivrent une indication d'une sélection, mais pas encore d'une confirmation d'une commutation croissante ou décroissante à partir d'un rapport de transmission actuellement engagé ou à partir de la position neutre en direction d'un rapport sélectionné;

à traiter lesdits premier et second signaux d'entrée au moyen de ladite unité (106) effectuant un traitement conformément à des règles logiques prédéterminées;

(a) pour déterminer le caractère souhaitable d'une commutation à partir d'un rapport actuellement engagé, pour sélectionner un tel changement de rapport s'il est souhaitable et envoyer des signaux de sortie de commande auxdits moyens de signalisation pour fournir une indication du fait que, selon ce qui est approprié, un passage à un rapport supérieur ou un rapport inférieur a été sélectionné;

(b) détecter la présence ou l'absence de conditions prédéterminées, dans lesquelles l'exécution d'un changement de rapport présélectionné doit être empêchée;

(c) répondre à (i) la sélection d'un changement de rapport de la transmission à partir d'un rapport actuellement engagé et à (ii) l'absence desdites conditions prédéterminées, grâce à la délivrance d'autres signaux de sortie de commande audit actionneur pour activer la transmission devant être commutée dans la position neutre;

(d) répondre à la fois à (i) une sélection d'une commutation d'un rapport actuellement engagé à un rapport sélectionné et à (ii) une confirmation d'une position neutre de la transmission, avec (i) détection d'une quasi-synchronisation manuelle de la transmission et (ii) envoi ultérieur d'autres signaux de sortie de

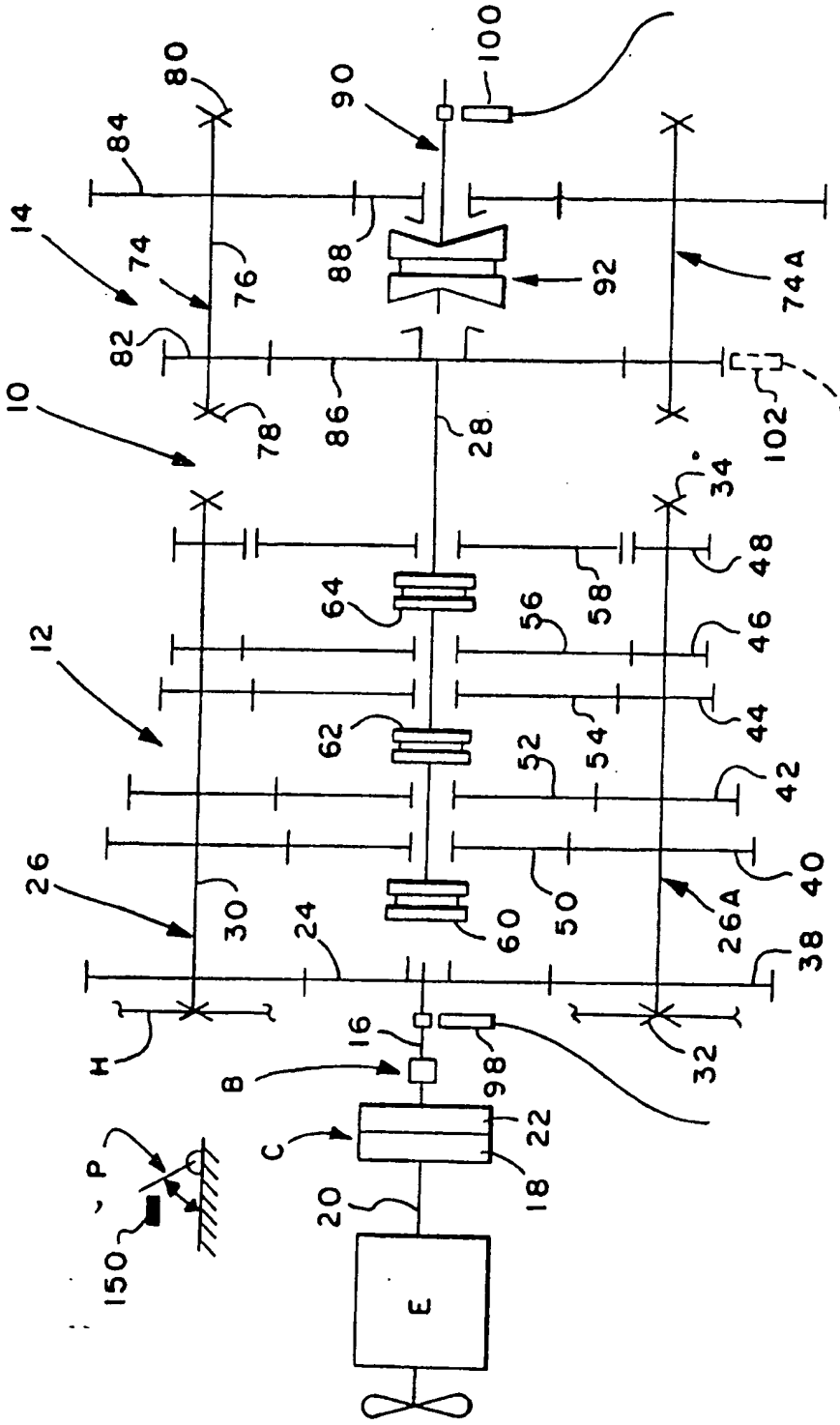
commande audit actionneur pour commuter la transmission sur le rapport sélectionné; et
(e) confirmer qu'un changement de rapport sélectionné a été exécuté et envoyer d'autres signaux de sortie de commande auxdits moyens de signalisation pour interrompre l'indication d'un changement de rapport sélectionné.

11. Procédé de commande selon la revendication 10, pouvant être mis en oeuvre de telle sorte que ledit second signal d'entrée indique en permanence la vitesse de l'arbre de sortie (90) de la transmission et de telle sorte que lesdites conditions prédéterminées incluent le fait que le second signal est inférieur à une valeur de référence prédéterminée.

12. Procédé de commande selon la revendication 10 ou 11, pouvant être mis en oeuvre de telle sorte qu'un troisième capteur détecte un papillon des gaz commandé manuellement, dans la position de ralenti, et que lesdites conditions prédéterminées comprennent le réglage dudit papillon des gaz réglé manuellement, dans la position de ralenti.

13. Système de commande selon la revendication 10 ou 11 pouvant être mis en oeuvre de telle sorte qu'un troisième capteur détecte le serrage des freins du véhicule et que lesdites conditions prédéterminées incluent l'état serré desdits freins du véhicule.

14. Système de commande selon la revendication 10 ou 11, pouvant être mis en oeuvre de telle sorte qu'un troisième capteur détecte le serrage d'un ralentisseur du véhicule, et que lesdites conditions prédéterminées incluent l'état serré du ralentisseur du véhicule.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74A
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78
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62
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26A
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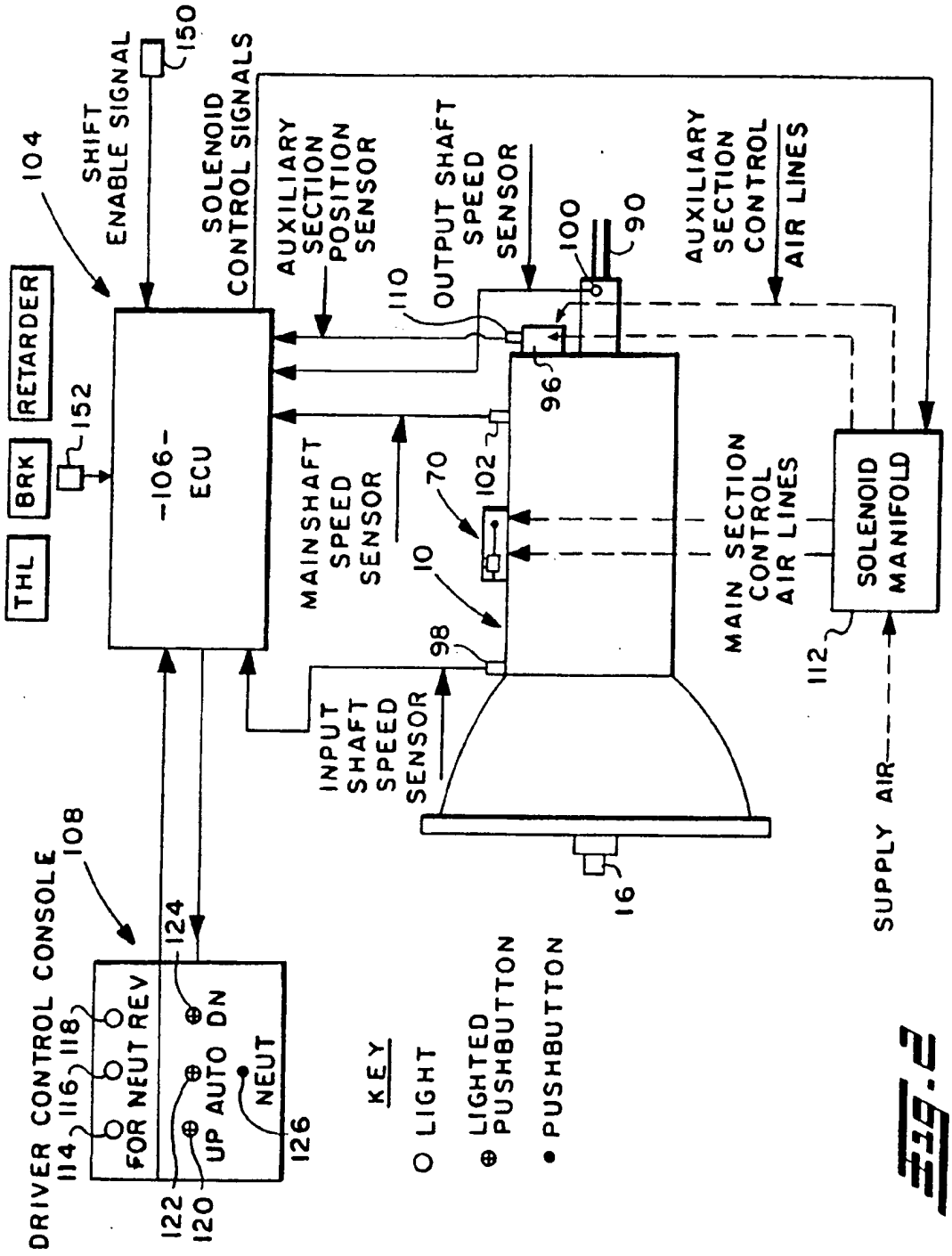
Fig. 1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SOLENOID CONTROL SIGNALS
AUXILIARY SECTION POSITION SENSOR
OUTPUT SHAFT SPEED SENSOR
AUXILIARY SECTION CONTROL AIR LINES
104
RETARDER
BRK
THL
152
-106- ECU
MAINSHAFT SPEED SENSOR
110
100
90
96
102
70
10
98
MAIN SECTION CONTROL AIR LINES
SOLENOID MANIFOLD
112
INPUT SHAFT SPEED SENSOR
16
SUPPLY AIR
DRIVER CONTROL CONSOLE
108
124
FOR NEUT REV
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114
116
118
122
120
126
KEY
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PUSHBUTTON

Fig. 2

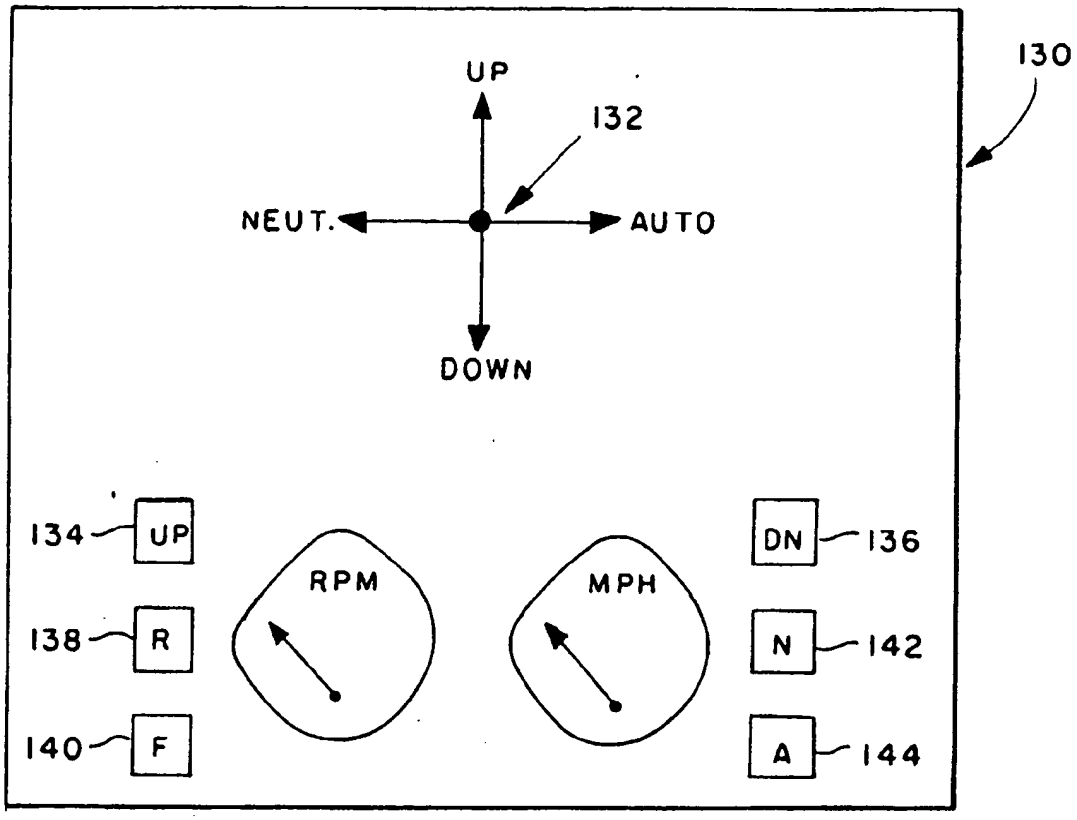
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Fig. 3

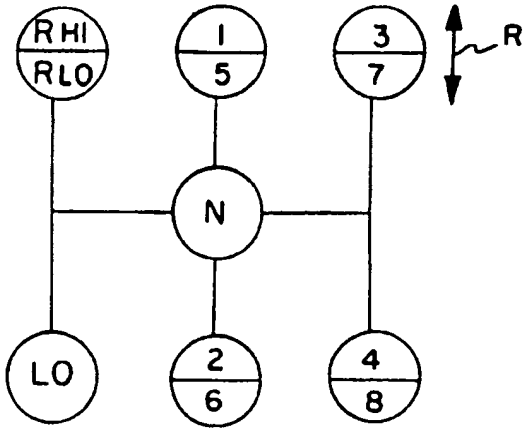
RHI
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Fig. 1A